ECLIPSE THERM-THIEF
Silicon Carbide
Radiant Auto-Recupes

- Low NOx and CO.
- High density silicon carbide flame & radiant tubes.
- Greater heat output than metallic tubes; fewer tubes required.
- Longer life expectancy than metallic tubes.
- Eliminates hot air ductwork.
- Distributes heat evenly down the radiant tube.
- Positions recuperative section in furnace wall for minimum heat loss.
- Integral air orifice meter simplifies adjustment.
- Special compression flanges protect tubes and eliminate bolt hole alignment problems.
- Vertical or horizontal mounting.

The Eclipse silicon carbide Radiant Auto-Recupe features high strength silicon carbide inner and radiant tubes that allow higher tube dissipation rates and temperatures than those attainable with metallic tubes. In most cases, they also withstand corrosive environments better than metallic tubes. This makes the Auto-Recupe an ideal replacement for electric heating elements.

The industry proven Auto-Recupe contains a nozzle-mixing burner and recuperator coaxially mounted inside of a single-ended radiant tube (SER). Combustion air entering the Auto-Recupe is preheated in the recuperative section by waste exhaust heat, providing fuel savings from 35% to 55% over radiant tubes equipped with sealed ambient air burners. When used to replace atmospheric burners, an additional 8% to 10% fuel savings can be achieved.

Materials—The silicon carbide Auto-Recupe is available with several grades of tube material to suit various applications. Reaction-bonded silicon carbide is used most often. This material has excellent mechanical strength, high temperature capabilities, and minimal susceptibility to thermal shock. Its high density provides a gas-tight heat transfer medium when used in protective atmospheres. Both the inner and outer tubes have integral mounting flanges.

Control Methods—Although high/low firing is preferred, on/off firing may be used when chamber temperatures are above 1550° F. Time proportional control is acceptable. Modulating control may be used only with special provisions and prior approval from Eclipse.
**FIRING RATES & EFFICIENCIES**

<table>
<thead>
<tr>
<th>Tube O.D.</th>
<th>High Fire Btu/hr. In 1000's</th>
<th>High Fire Efficiency¹ For Various Net Outputs, Btu/hr. in 1000's</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-1/4&quot;</td>
<td>Min.</td>
<td>Max.</td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>160</td>
</tr>
</tbody>
</table>

¹ Auto-Recupes burn cleanly with 10% excess air in this range.
² Approximate, based on 2000°F, furnace temperature and a burner length of 19".

**MAXIMUM HEAT TRANSFER RATES**

<table>
<thead>
<tr>
<th>Furnace Temp, °F.</th>
<th>1500</th>
<th>1700</th>
<th>1900</th>
<th>2100</th>
<th>2300</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Heat Transfer, Btu/hr./Sq. In.</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>60</td>
</tr>
</tbody>
</table>

* For higher temperature or input contact Eclipse.

**SIZING EXAMPLE**

**Application Parameters:**
- 1800°F, operating temperature
- 275,000 net Btu/hr required
- 55" available space for Auto-Recupe

**Tube surface area:**
Using an Auto-Recupe with a 50" effective length:
- Surface area = OD x π x effective length
  - = 3.25" x 3.14 x 50" = 510 in²

**Max. Heat Transfer Rate** (from chart): 150 Btu/in²/hr

**Max. Net Output Per Tube:**
- 510 in² x 150 Btu/in²/hr = 76,500 Btu/hr per tube

**Number of Tubes Required:**
- = net Btu/hr required ÷ Btu/hr per tube
- = 275,000 Btu/hr ÷ 76,500 Btu/hr/tube
- = 3.6 tubes, or four tubes

**Actual Heat Transfer Rate:**
- 510 in² per tube x 4 tubes = 2040 in² total area
- 275,000 Btu/hr required ÷ 2040 in² = 134.8 Btu/in²/hr

**Actual Net Output Per Tube:**
- 275,000 Btu/hr ÷ 4 tubes = 68,750 Btu/hr per tube

**Gross Input per Tube:**
- Gross Input = Net output ÷ Efficiency
  - = 68,750 Btu/hr ÷ .61 (from chart)
  - = 112,705 Btu/hr

If the tubes were fired at the maximum heat transfer rate of 150 Btu/in², net output could be increased to 76,500 Btu/hr per tube, or 306,000 Btu/hr for the system.

**DIMENSIONS**

Tubes may be mounted vertically or horizontally. For horizontal installation, internal tube spacer #13245 must be ordered with the burner. Horizontal installation will also require external tube support as detailed in Into 322.
COMBUSTION AIR DATA

The combustion air high fire supply pressure at the inlet to the Auto-Recupe must equal the required burner air pressure from the table below plus the air pressure drop across the integral air metering orifice as shown in the graph.

Each metering orifice is supplied with two standard orifice plates—.625" and .875"—installed. If the combustion air supply pressure is high enough for the smaller of the two orifices supplied, leave both plates between the flanges. If supply pressure is too low for the small diameter orifice, loosen the flange bolts and slip out the smaller orifice plate, leaving the larger one in place.

Example: The Auto-Recupes selected on the previous page, at an input of 113,000 Btu/hr., will require 15" w.c. air pressure as shown in the table below. The .875" orifice would take an additional 3.5" w.c. drop at this input, as shown in the graph below. Thus, an air supply pressure of 18.5" would be required for the SER with the .875" orifice fitted.

If the .625" orifice were left in place, it would have a drop exceeding 10" w.c., requiring an air supply pressure approaching 30" w.c. To avoid this high pressure, the .625" orifice should be removed from the SER during installation.

### Burner Air & Gas Pressures Required

<table>
<thead>
<tr>
<th>Btu/hr. Input in 1000's</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>100</th>
<th>120</th>
<th>140</th>
<th>160</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Pressure, &quot;W.C.&quot;</td>
<td>1.2</td>
<td>1.7</td>
<td>2.5</td>
<td>3.7</td>
<td>5.2</td>
<td>6.8</td>
<td>8.4</td>
<td>12.5</td>
<td>17.8</td>
<td>23.2</td>
<td>30</td>
</tr>
<tr>
<td>Gas Pressure, &quot;W.C.&quot;</td>
<td>0.8</td>
<td>1.2</td>
<td>1.8</td>
<td>2.7</td>
<td>4.0</td>
<td>5.2</td>
<td>6.5</td>
<td>9.5</td>
<td>13.5</td>
<td>17.5</td>
<td>22.0</td>
</tr>
</tbody>
</table>

### High Fire Air Pressure Drop Across Metering Orifice

*15% Excess Air*

### Low Fire Air Pressure Drop Across Metering Orifice

*0.625" Orifice:* 0.4" w.c. with 14% O₂.
   Low fire input is 5000 Btu/hr.

*0.875" Orifice:* 0.4" w.c. with 14% O₂.
   Low fire input is 10,000 Btu/hr.

### CAUTION

It is dangerous to use any fuel burning equipment unless it is equipped with suitable flame sensing devices and automatic fuel shut-off valves. Eclipse can supply such equipment or information on alternate sources.